Posterior Circulation Stroke Following Embolization of Glomus Tympanicum – Relevance of Anatomy and Anastomoses of Ascending Pharyngeal Artery

A Case Report

V. SAWLANI, S. BROWNING, I.M. SAWHNEY, R. REDFERN

Morriston Hospital; Swansea, U.K.

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Summary

Embolization in the territory of the ascending pharyngeal artery (APA) can be unsafe even after detailed pretherapeutic angiographic evaluation due to changes in haemodynamics and opening of anastomotic channels. A 60-year-old woman underwent angiogram and embolization for glomus tympanicum tumour. The glomus tympanicum tumour was embolized using contour PVA particles of 150-250 um. At the end of the particulate injection the patient had posterior circulation stroke. The check angiogram showed near total devascularisation of the tumour and in addition filling of the left vertebral artery through an anastomotic channel. MRI confirmed the infarct in the posterior circulation.

The ascending pharyngeal artery has potential anastomoses to all neighbouring major arteries, and the anastomoses to the vertebral artery in our case were through the musculospinal artery. This case highlights the importance of potential vascular anastomotic channels as a cause of ischaemic complication during the embolization procedure. It also highlights the fact that dangerous anastomoses may only be visualised in the later phase of embolization probably due to changes in the haemodynamic pressure. The angiographic anatomy of APA is reviewed with potential communications with the internal and external carotid and vertebrobasilar systems.

Introduction

The ascending pharyngeal artery is a small but important artery that supplies multiple cranial nerves and anastomotic channels to the anterior and posterior cerebral circulation. To embolize in the terrain of the APA it is necessary for the neuroradiologist to understand the anatomy and subtle anastomotic channels which can be potentially dangerous due to changes in haemodynamics during and after the embolization procedure. The angiographic anatomy of the APA is reviewed with potential communications with the internal and external carotid and vertebrobasilar systems.

Case Report

A general practitioner referred a 60-year-old woman was to the department of otolaryngology by with a two year history of left-sided pulsatile tinnitus. Otoscopy revealed a red, smooth, pulsatile lesion behind the tympanic membrane. CT and MRI scan confirmed the presence of a small soft tissue mass in the left middle ear cavity inferior to the middle ear ossicles consistent with glomus tympanicum tumour.

A diagnostic angiogram was performed to evaluate the vascular anatomy and the feeder of the glomus tumour. Selective left ascending

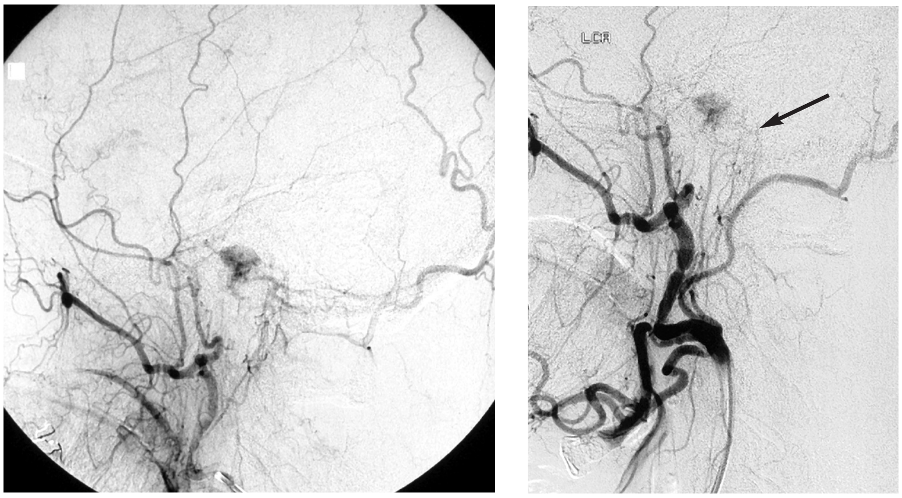

Figure 1 Left external carotid angiogram shows tumour blush consistent with glomus tympanicum tumour supplied by the ascending pharyngeal artery (APA) (arrow).

A B C D

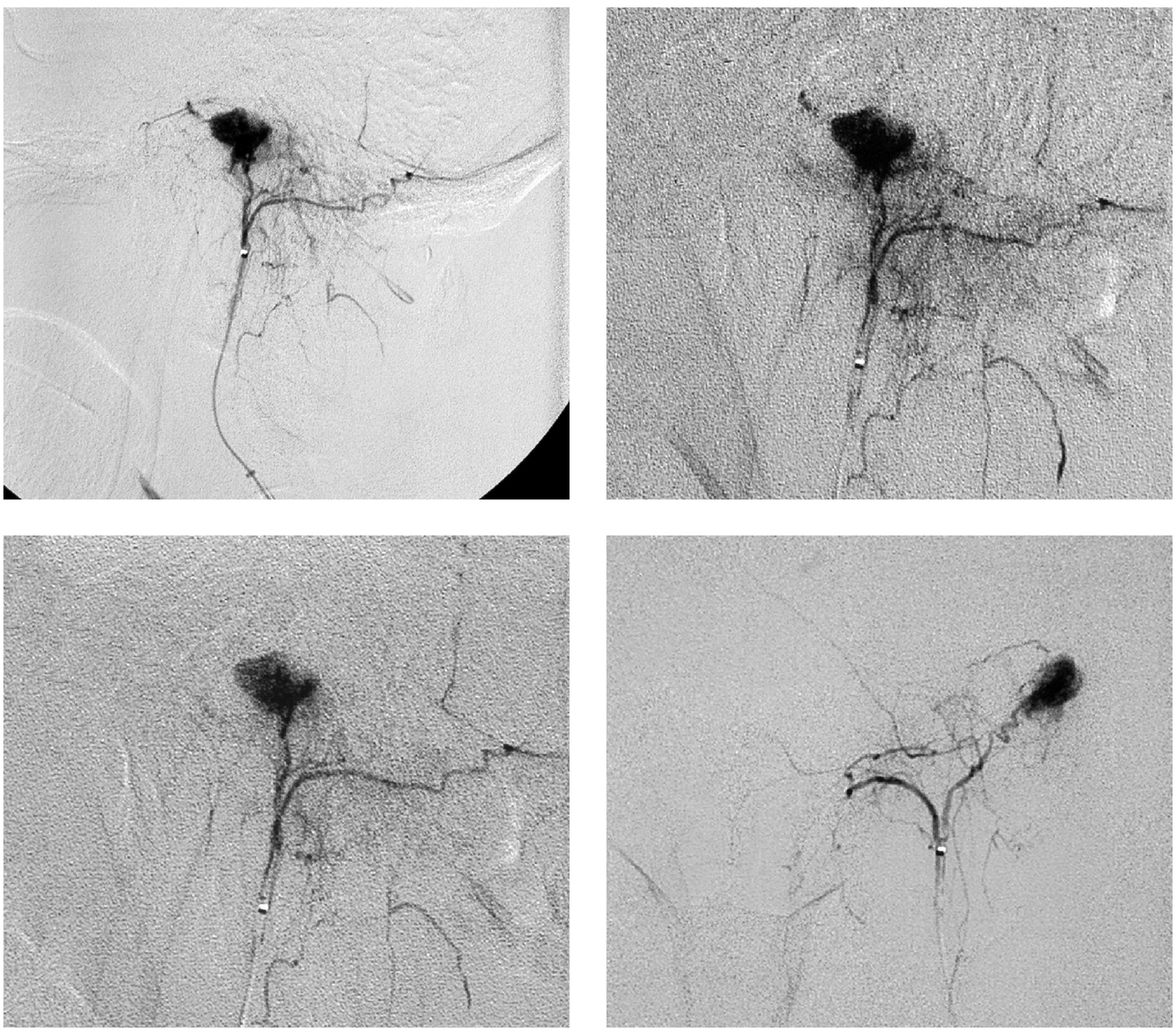

Figure 2 A-D) Distal ascending pharyngeal microcatheter angiogram in AP, lateral and oblique views show glomus tumour fed by inferior tympanic artery, a branch of neuromeningeal division of APA.

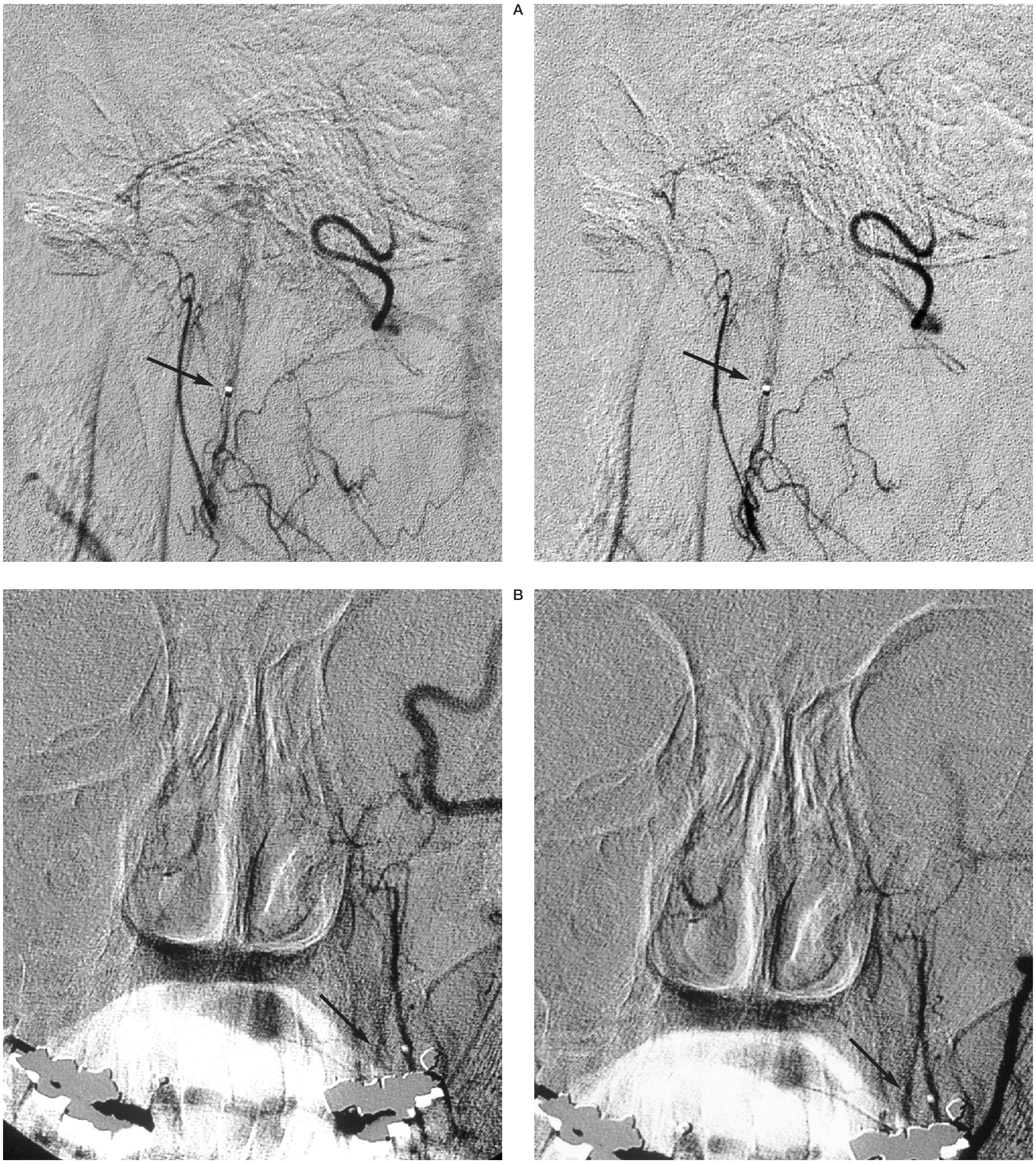

Figure 3 A,B) The post embolization check angiogram in AP and lateral view show devascularisation of the tumour. In addition there is filling of left vertebral artery through anastomotic channel (musculospinal artery) between the left APA and the vertebral artery. The microcatheter tip is seen in the distal APA (arrow).

pharyngeal angiography showed an intense tumoral blush in the left petrous temporal bone region being fed by the inferior tympanic artery, a branch of neuromeningeal division of the APA (Figures 1 and 2). Selective cannulation of the inferior tympanic artery was achieved by the coaxial microcatheter system. The glomus tympanicum tumour was embolized using contour PVA particles of 150-25 um. At the end of the particulate injection the patient became disorientated and confused, neurological examination was otherwise unre-

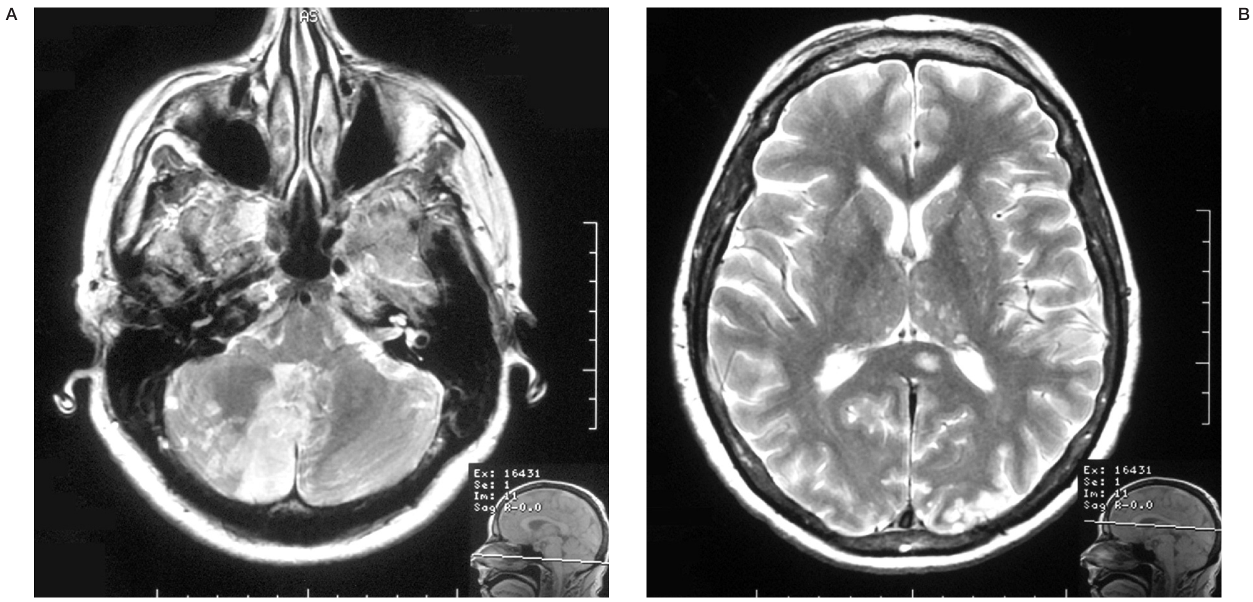

Figure 4 A,B) T2W axial MRI shows a focal infarct in the right medial inferior cerebellar hemisphere and multiple small hyper intense foci in bilateral thalami. The appearance is consistent with the reflux of particles in posterior circulation.

markable. The check angiogram showed near total de-vascularisation of the tumour and filling of the left vertebral artery through an anastomotic channel between the left ascending pharyngeal artery and the vertebrobasilar artery (Figure 3). Immediate post embolization CT was normal.

MRI performed five days later showed a focal wedge-shaped infarct in the right medial and inferior cerebellar hemisphere and multiple small hyperintense foci in the bilateral posterior cerebral artery territory, temporal-occipital lobes and thalami (Figure 4). The appearance was consistent with a reflux of particles in the posterior circulation. The patient made a good clinical recovery following posterior circulation stroke in six weeks and was successfully operated for the glomus tumour.

Discussion

Glomus tympanicum tumour arises from paraganglionic cells associated with Jacobsen's and Arnold's nerves within the middle ear. They occur more commonly in Caucasians and have a female preponderance [1]. They usually present in the fifth and sixth decades of life and are slow growing and rarely metastasize. Imaging is crucial to distinguish between glomus tympanicum and glomus jugulare tumours, to exclude synchronous tumours and to delineate the extent of the tumour to aid with operative planning.

Treatment may be conservative or surgical depending on the extent of symptoms, patient age and comorbid factors. Surgery is the gold standard treatment [2]. Radiation therapy can be considered in cases of recurrence and as an alternative option for patients [2]. Pre-operative embolization of glomus tumours can reduce operative blood loss, minimise the risk of operative complications and prevent recurrence by contributing to complete resection [3]. It may also provide additional symptomatic relief by decreasing tumour volume and has been used to treat patients with inoperable tumours [3].

The ascending pharyngeal artery is a small but important artery that arises from the external carotid artery and supplies multiple cranial nerves and has many anastomotic channels to the anterior and posterior cerebral circulation [4]. In our patient the glomus tympanicum tumour was supplied by the inferior tympanic artery a branch of the APA. There was no connection seen between the ascending pharyngeal and vertebral artery on the pretherapeutic diagnostic angiogram. The patient suffered a posterior circulation stroke following embolization of the glomus tumour probably secondary to changes in haemodynamics and opening of the

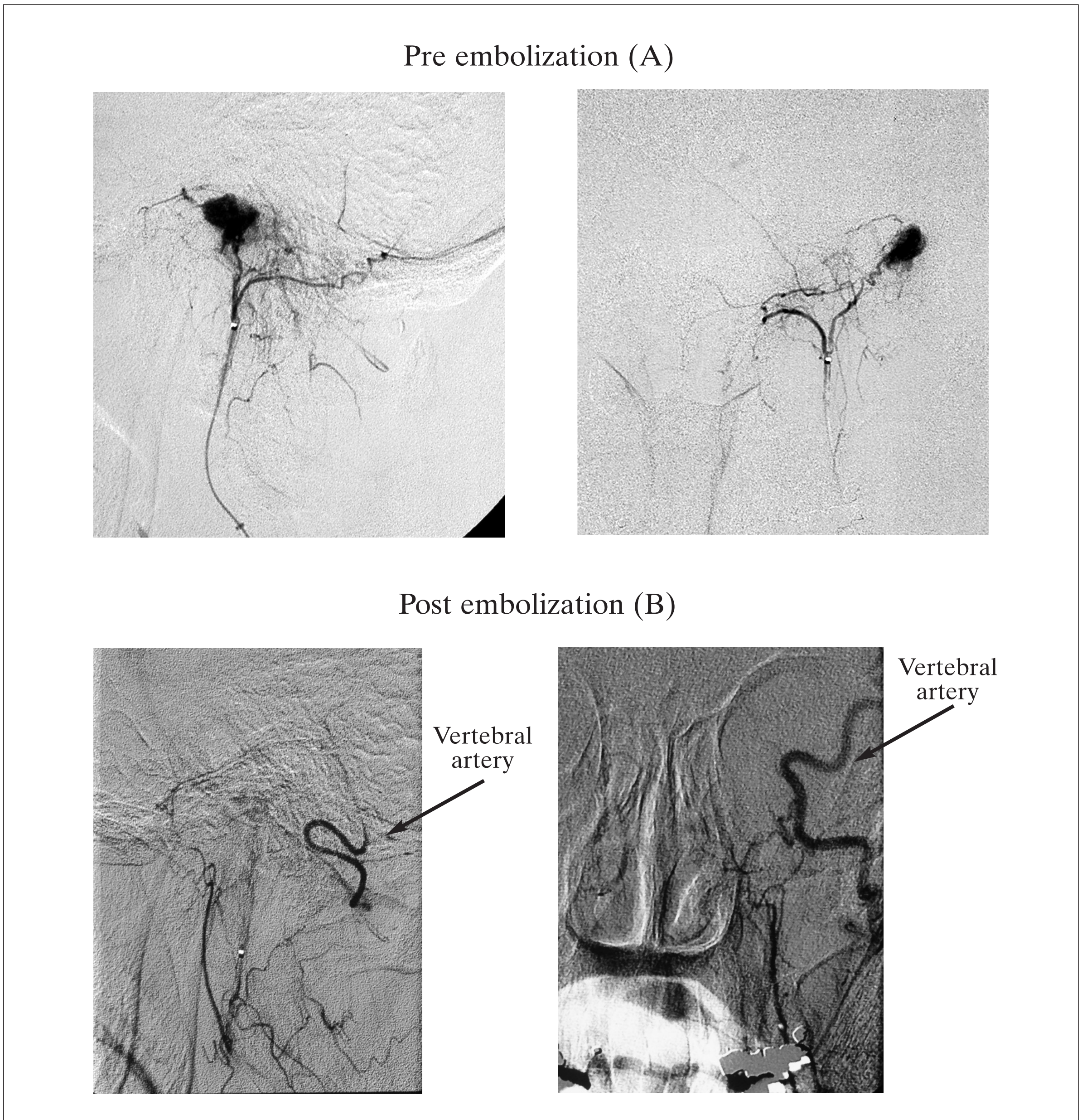

Figure 5 Pre (A) and post (B) embolization angiogram with catheter tip in the distal APA. The filing of vertebral artery (arrow) in APA injection towards the end of embolization suggests an anastomotic channel (musculospinal artery) between the APA and vertebral artery.

anastomotic channel between the APA and vertebrobasilar system allowing reflux of particles into the posterior circulation. The ascending pharyngeal artery has potential anastomoses to all neighbouring major arteries, and anastomoses to the vertebral artery are through the hypoglossal and the musculospinal artery[4] (Figures 5B and 7).

There are two cases of ascending pharyngeal-vertebral anastomoses reported in the English literature[5,6]. Shimamura reported a case of ascending pharyngeal-vertebral anastomoses with bilateral absence of the vertebral arteries incidentally found during angiographic investigation[5]. Nierling reported the case of a 56-year-old with cerebrovascular insufficiency. Carotid angiography showed occlusion of the origin of the internal carotid artery and filling

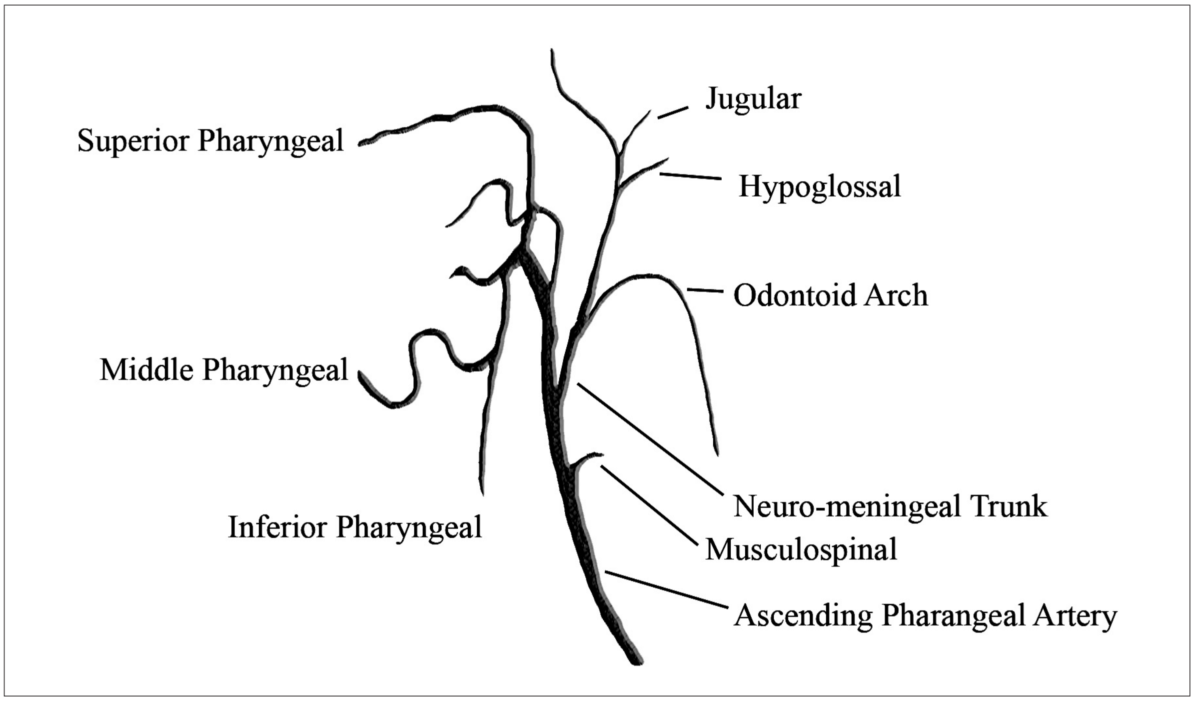

Figure 6 Anatomy - ascending pharyngeal artery.

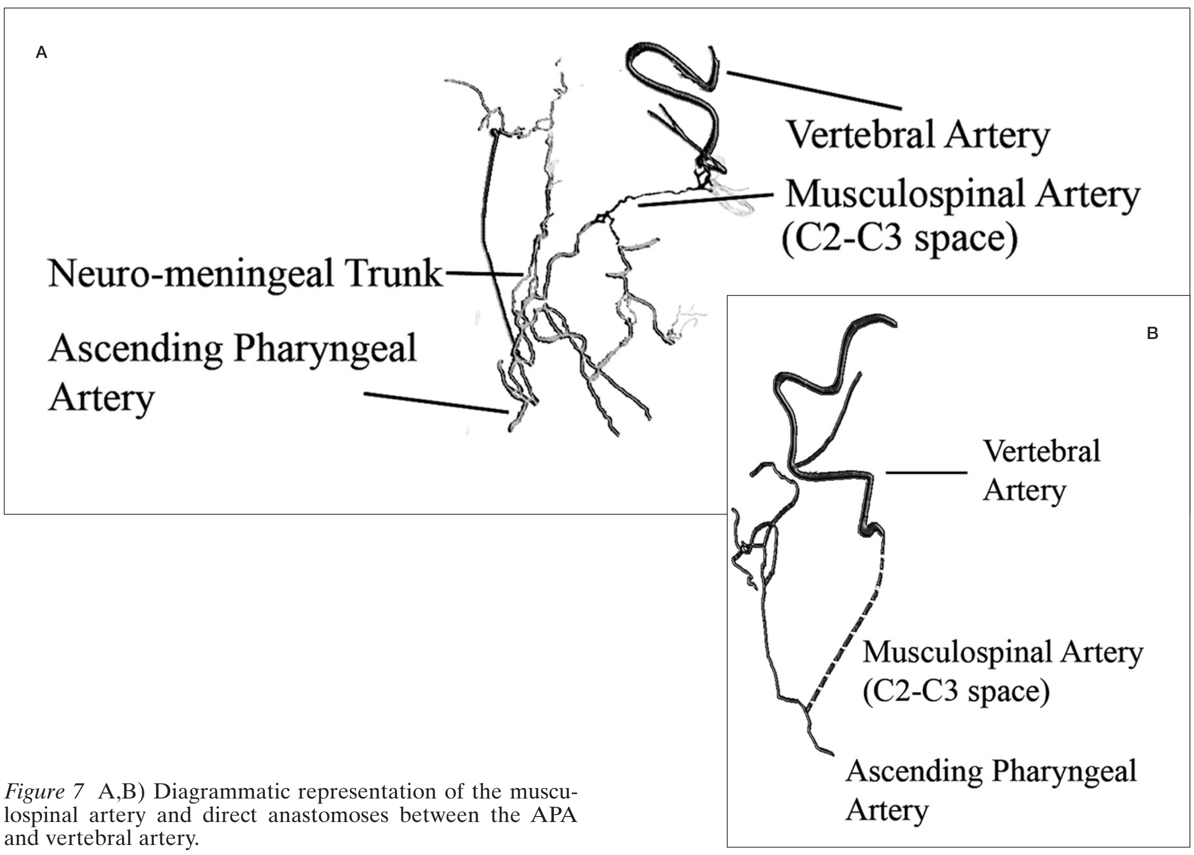

Figure 7 A,B) Diagrammatic representation of the musculospinal artery and direct anastomoses between the APA and vertebral artery.

of the vertebrobasilar artery via the ascending pharyngeal artery at the level of the C2 vertebral body [6]. Both these reports demonstrate the potential anastomotic channels between APA and VBA. The ascending pharyngeal artery may also act as a collateral pathway in complete occlusion of the internal carotid artery [9].

The current case highlights the importance of potential vascular anastomotic channels as a cause for ischemic complications during the embolization procedure. It also highlights the fact that dangerous anastomoses may only be visualised in the later phase of embolization probably due to changes in the haemodynamic pressure (Figures 3 and 5).

Anatomy

The ascending pharyngeal artery (APA) arises from the posterior wall of the proximal external carotid artery [4,7,8]. The APA may arise from the proximal occipital artery and rarely from the internal carotid artery [4]. The APA divides into two major trunks anteriorly, the pharyngeal trunk and posteriorly the neuromeningeal trunk. The pharyngeal trunk is extracranial but has arterial anastomoses with the sphenopalatine system (Figure 6). The superior pharyngeal artery through the carotid branch may anastomose with the inferolateral trunk. The posterior neuromeningeal trunk is intracranial and enters the posterior fossa through the foramen magnum. In rare instances, the neuromeningeal trunk may arise from the occipital artery or posterior auricular artery.

The two main divisions of the neuromeningeal trunk are the hypoglossal and jugular branches. The hypoglossal branch extends to the posterior fossa to the hypoglossal canal. It supplies the meninges of the posterior fossa and the vasa nervorum of cranial nerve XII. The posterior descending branch contributes to the odontoid arch system. It also provides several branches that supply the first, second and third cervical roots. At the C2-C3 intervertebral space, it anastomoses with the vertebral artery. The jugular branch extends to the posterior fossa to the jugular foramen. It supplies the vasa nervosum of cranial nerves IX, X, XI.

The inferior tympanic artery most commonly arises from the proximal aspect of the neuromeningeal trunk but can also arise as a separate branch between the pharyngeal and neuromeningeal trunks. It provides anastomotic branches to the caroticotympanic branch of the ICA, petrososquamosal branch of the middle meningeal artery and an anastomotic branch to the stylomastoid artery. The musculospinal artery anastomoses with the vertebral artery at the level of third intervertebral space (C2-C3).

Anastomoses to major arteries

The ascending pharyngeal artery has potential anastomoses to all neighbouring arteries [4,7,8]. Anastomoses to the internal carotid artery are either direct via the lateral clival branch of the jugular artery or the recurrent artery of the foramen lacerum or indirect via the superior pharyngeal branch to the inferolateral trunk, the clival branches to the meningohypophyseal trunk or the inferior tympanic branch to the caroticotympanic branch. Anastomoses to the vertebral artery are through the hypoglossal branch and the musculospinal branch (Figure 7 A,B). Anastomoses to the occipital artery can be either indirect through the odontoid arch system or direct through a common trunk. The ascending pharyngeal artery is connected to the internal maxillary artery at the level of the descending palatine artery through the middle pharyngeal branch or the pterygovaginal artery to the accessory meningeal artery.

Conclusions

In our case the glomus tympanicum tumour was supplied by the inferior tympanic artery, a branch of the APA. There was no connection seen between the ascending pharyngeal and vertebral arteries on the pretherapeutic diagnostic angiogram. The patient suffered a posterior circulation stroke following embolization of the glomus tumour due to opening of an anastomotic channel between the ascending pharyngeal and vertebral arteries allowing reflux of particles through the musculospinal artery in the posterior circulation secondary to changes in haemodynamics.

The ascending pharyngeal artery is important in multiple clinical situations in which interventional neuroradiology management plays a central role. Apart from the technical skills and embolization technique, a detailed knowledge of anatomy, anastomoses and haemodynamics is mandatory for a safe embolization procedure in the ascending pharyngeal artery territory.

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Dr Vijay Sawlani, M.D.
Morriston Hospital
Swansea
United Kingdom
E-mail: vijaysawlani@hotmail.com